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Consequently

$$\frac{\sqrt[3]{27+6\sqrt{21}}+\sqrt[3]{27-6\sqrt{21}}}{3}=1,$$

the result expected from the equation $x^3+x-2=0$.

The method may be extended, and holds when a, b and c are negative as well as positive. Likewise the proof holds when the required root can be found in the form $a\sqrt{b}+c\sqrt{d}$.

The latter expression gives rise to the cubic equation

$$4bx^3-3x\sqrt[3]{a^2b-c^2d}-a=0. \tag{8}$$

Example 1. To find the cube root of $2,261\sqrt{2}-1,845\sqrt{3}$. Here $a=2,261$, $b=2$, $c=-1,845$, $d=3$.

$$\sqrt[3]{a^2b-c^2d}=\sqrt[3]{10,224,242-10,212,075}=\sqrt[3]{12,167}=23.$$

Substituting this value in (8), the equation becomes

$$8x^3-69x-2,261=0,$$

and

$$x=7,\quad y=5.$$

Therefore the cube root of $2,261\sqrt{2}-1,845\sqrt{3}$ is $7\sqrt{2}-5\sqrt{3}$.

Example 2. To find the cube root of $276\sqrt{3}-70\sqrt{-2}$. Here $a=276$, $b=3$, $c=-70$, $d=-2$.

$$\sqrt[3]{a^2b-c^2d}=\sqrt[3]{228,528+9,800}=\sqrt[3]{238,328}=62.$$

Substituting this value in (8), the equation becomes

$$12x^3-186x-276=0,$$

whence $x=-2$, and $y=5$. Consequently the cube root of $276\sqrt{3}-70\sqrt{-2}$ is $-2\sqrt{3}+5\sqrt{-2}$.

BOOK REVIEWS.

W. H. Bussey, Chairman of the Committee.

Trigonometry for Schools and Colleges. By Frederick Anderegg and Edward Drake Roe. Revised edition by Frederick Anderegg. Ginn and Company, Boston, 1913. ix + 108 pages. 75 cents.

The characteristics which insured for this little book a favorable reception in its first edition, namely clearness and conciseness, have been retained in this new edition.

The striking alterations effected in the revision of the plane trigonometry touch the solution of triangles. The right triangle is solved in the third chapter instead of in the sixth and model solutions of both right and oblique triangles are added. The discussion of the various cases has been somewhat elaborated and the number of numerical exercises increased.

In the more theoretical part of the text there are many minor changes in the direction of brevity, which completely compensate for the additions and leave the number of pages unaltered.

There are no changes in that part of the book which deals with spherical trigonometry.

J. W. BRADSHAW.

An Introduction to the Mathematical Theory of Heat Conduction. By L. R. INGERSOLL and O. J. ZOBEL. Ginn and Co., Boston, 1913. 171 pages.

This is a handy little volume on the Fourier theory, intended partly as an introduction to the general methods of mathematical physics, or rather of those parts which are concerned with boundary-value problems in the integration of partial differential equations, partly to give an account of a number of special problems selected from the wide range of applications in physics, engineering, and geology, as the sub-title suggests. In view of this two-fold aim it is convenient to consider separately the treatment of the general theory and of the special problems.

As one would expect, the general mathematical material introduced coincides in the main with that contained in the more elementary portions of Fourier's own work, with more modern notation and some simplification of arrangement. It covers the more important of those cases of steady and variable distribution of temperature which are solvable by simple formulæ in elementary functions, by ordinary trigonometric series, or by Fourier's integral, either directly or by the device of extension of the realm of definition of a function such as to make certain boundary properties automatic. The problem of the sphere is also included, as solved for the case of spherical isothermals by generalized Fourier series.

In the more purely mathematical portions of the book there are a number of things which seem to call for criticism, a few of which may be named here. Certain infinite series used in leading up to Fourier's integral are not convergent, and the integral itself is written in some places so that the inner integral diverges. In the explanation of the formula of conduction the terms "plane" and "lamina" seem to be used as synonymous. In one place it is stated that the assumption of expansibility of a function into a sine-series is to be considered justified if values can be found for the coefficients. The term "general solution," from which special solutions are to be obtained by "substituting," is used, without any real need, in connection with partial differential equations, where the notion is practically useless and usually disagreeably vague unless taken in the unenlightening sense of the class of all solutions; then the comforting assurance is added that many cases can be solved by other methods, even when it would be "almost impossible" to obtain the general solution of the differential equation. These few instances illustrate an occasional looseness of expression which one could